

Interactive Study on Morphological Image Processing through LabVIEW

Shraddha Gangwar¹ and Rishi Pal Chauhan²

^{1,2}National Institute of Technology Kurukshetra Kurukshetra-India
E-mail: ¹shraddhagangwar@gmail.com, ²chauhanrpc@gmail.com

Abstract—LabVIEW, a platform for many of the applicative technologies presents a discrete and interactive methodology to apply various morphological operations to an image. An interactive setup has been produced to interact, enhance, modulate and recreate the numerous properties of an image. A user is given a chance to apply changes that can be preserved and a combination of multiple operations can be utilized to produce desired output. It supports almost all formats of images like png, jpg, jpeg etc. To add more, implementation of this platform allows scalability of the size of image and the structuring element. A beginner gets a complete interactive opportunity to learn morphological image processing and the related tools and techniques. The processing is fast and involves less complexity. User has the sole right to adjust and even select threshold values. Almost, every possible operations like opening, closing, dilation, erosion etc are available.

1. INTRODUCTION

Morphological image processing is very well known as one of the most efficient methodology encompassing image processing and computer vision [1-2]. It is often used in various tasks of image processing and its analysis, precisely suppression of noise, image enhancement, image code and extraction of various features in it, detailed analysis of texture, recognition of shape and so on [3-7]. Going deeper into its technicality, the mathematical morphology was primarily oriented to binary image and was so called as binary morphology. After then, based on umbrella theory, Serra and Sternberg extended the traditional binary morphology to gray-scale image processing technique [8] and enhanced binary morphological operators to gray-scale image by maximum and minimum type of operators.

Morphological techniques probe an image with a small shaped and sized or template called a structuring element. This element is placed at every possible location in the image and it is compared with the corresponding adjacent pixels. Morphological image processing has proved to be a powerful tool for binary and grayscale image computer vision and further processing tasks, like edge detection, suppression of noise, segmentation, recognition of pattern and enhancement. Initial applications of morphological processing were in biomedical and geological problems related to image analysis. In the 1980's, extensions of the classical mathematical

morphology and connections with other knowledge areas were worldwide established by several research groups along various directions, including applications to the computer vision issues, multiscale image processing, various statistical analysis and optimal design of morphological filters [9].

In this paper, we have tried our best to bring about the recent developments that have been done in the LabVIEW environment and has thus familiarized us more with the Image processing techniques and more specifically the morphological processing of images.

The complete work has been carried out at IIT Roorkee(Virtual Labs). Here practical applications are introduced from an operational idea with some exposure to general theory. To encourage further a web-based educational system and enhanced visualization tools are made available to students for downloading so they may experiment with the tools at their own leisure.

2. LABVIEW

LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a defined platform for graphical programming or G-language [10]. It is used to create programs or files called Virtual Instruments or VIs. LabVIEW includes many tools for typical as well as fundamental operations such as acquisition of data, analysis and display of results. It contains enormous functions in various areas such as signal generation, signal processing, filtering and statistics. Each of the VI contains 3 parts:

2.1 Front Panel

This is the user interface place and it contains elements like controls (inputs) and various indicators (outputs). Fig. 1 will display the front panel of the Virtual Lab VI.

2.2 Block Diagram

This section contains mainly the source code of the VI. Front panel objects have the corresponding and related terminals on the block diagram to allow data to flow from the user to the program and hence back to the user again. It portrays one

more, in a way lower-level VIs and they are mainly built in functions which are basically connected using wires to indicate the dataflow. Fig. 2 shows the block diagram of the Virtual Lab VI.

2.3 Sub VIs

These are almost analogous to the subroutines in the conventional available programming languages. Probably in the various image processing applications used, the execution speed is highly critical. LabVIEW has been seen as the only graphical programming system with a compiler of its own that generates an optimized code with execution which has speed almost comparable to compiled C programs. Thus, LabVIEW has the ability to create and execute stand-alone executable applications, which run at higher compiled execution speeds. Another advantage of LabVIEW is the fact that it includes built in applications, such as the IMAQ Vision for enhanced image processing which has more than 400 imaging functions and interactive imaging windows and other utilities for displaying and building interactive imaging systems. [11] Provides information on IMAQ Vision.

3. IMPLEMENTED TECHNIQUES

The image processing environment developed here is processed using the LabVIEW 2010. In addition to the system software, various images have been used as the test cases.

Talking in detail, the major morphological operations that have been examined here are open, close, erode and dilate. Now we will consider each and every operation in further detailed description.

3.1 Morphological Dilation

Dilation is an operation which grows or thickens the objects in the image under test. The specific way or you can say that the extent of thickening is largely dependent on the selection of an element called the structural element. Structural Element may vary in shape and size depending upon the change to be brought about. The idea of the structuring element is to move about and over the object of the image. As per the required operation, the movement of the structural element will thicken the object considering the number of iterations to be performed. Once the image is loaded and the defined process and the number of iterations are defined, comes the turn where the threshold value is to be selected. This in the given methodology has been set from 0 to 255. Next step is to click on the button process to develop the output and the threshold images concurrently. User is given a chance to save this image to his/her own system. Fig. 3 shows the dilation operation performed with the achieved results.

3.2 Morphological Erosion

Erosion is the property as the name suggests is mainly used to thin or shrink the object of the image. Only considering the specified part or the object of the image we are bothered about the sectional object and not the background image. Here the

user is again given a chance to select the type or kind of the structural element and the level of the threshold value. The number of iterations will decide the level or the intensity to which the object had been made thin or has been shrunk. Once the structural element, threshold value, and the number of iterations have been decided then comes the option to press the process button. Once the user clicks this button, there displays the threshold image, and the final eroded image. User has the advantage to make comparable justifications looking at the original and the resultant images. Fig. 4 displays the erosion operation performed and its optimum results.

3.3 Morphological Opening

In practical image processing applications, dilation and erosion are being used most often and that too with various combinations. An image undergoes series of dilations and/or erosions using the same, or another structural element. User is now very much well aware of the morphological erosion and dilation and so it becomes a familiar task to introduce morphological opening. It is simply combination of erosion and dilation or can be better explained as the erosion process to be followed by dilation process. This is done of the constituent parts of the image which has undergone the test. Fig 5 will display the opening operation being performed with the results. Again, user is required to choose a particular structural element, threshold value and the required number of iterations of opening operation to be performed. All the processes are done on the loaded image will yield the desired results.

3.4 Morphological Closing

This is again the preprocessed combinations of initially discussed operations called erosion and dilation but performed mathematically in the opposite manner as the opening is performed. It comprises of the dilation process followed by the erosion. For the attainment and the comparison of the test cases one is required to carefully select the shape size and other measures of the structural element. Initially when the user selects the images from the system/browser, selection of the button load image will present the image in a frontal window which automatically converts image into grayscale range. After that, the selection of threshold range and possible number of iterations will further decide the processing of image to take place. Once the selection is done, user is required to click process button which will present the desired results. User can store and reuse these results for further applications. Fig .6 shows the closing operation is being performed. And Fig. 7. is the original image under test.

4. CONCLUSION

In this paper, powerful tools have been described which have been developed using LabVIEW for enhanced image processing studies for the scholars. An overview of LabVIEW and its related advanced techniques have been used for further enhancement of images.



Fig. 1: Front Panel

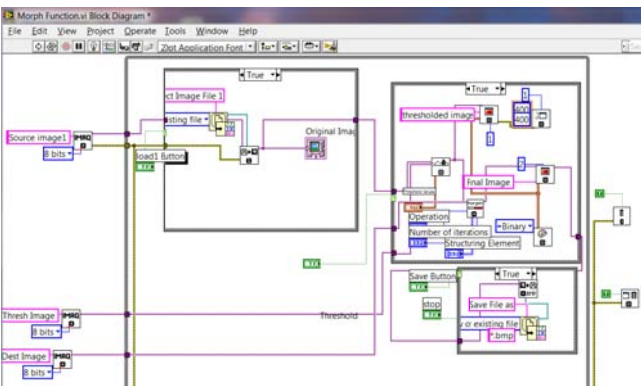
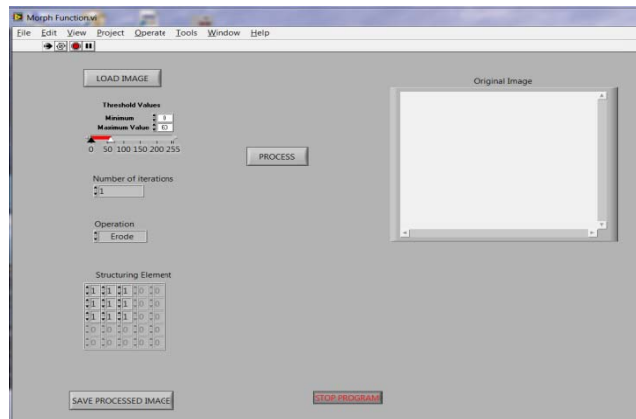


Fig. 2: Block Diagram



Fig. 3: Dilated Image Fig. 7. Original Image

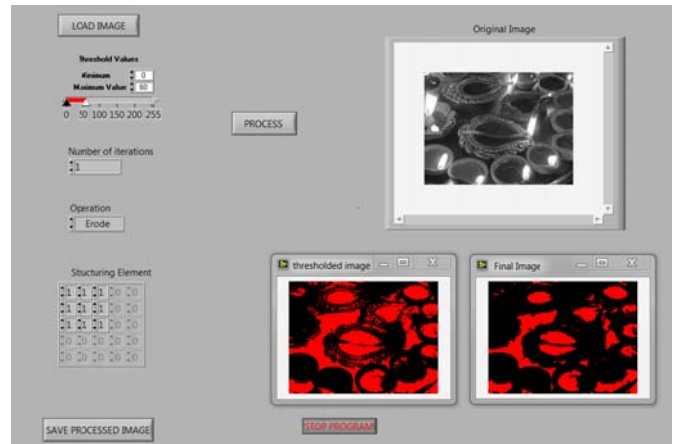


Fig. 4: Eroded Image

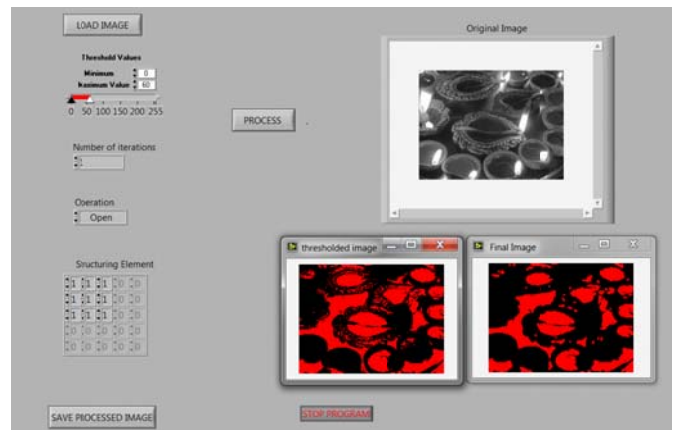


Fig. 5: Open Image

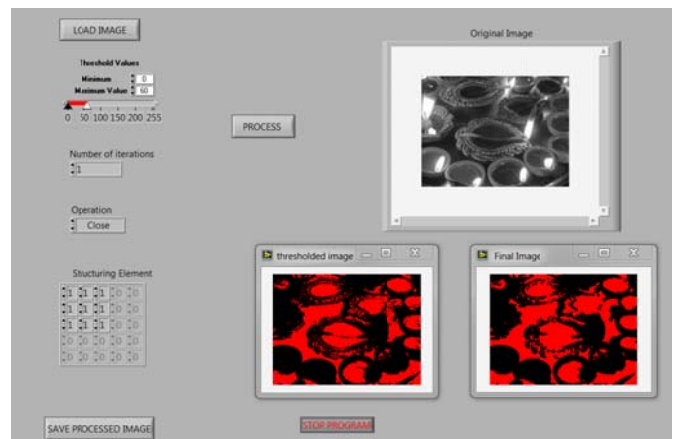


Fig. 6: Close Image

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